3.9 NOISE

This section documents existing noise conditions at 15 locations in the project vicinity and presents projected noise levels resulting from the operation of the proposed project. For the purpose of this evaluation, projected noise levels must exceed regulatory residential, commercial, or industrial noise standards to be considered an impact requiring mitigation.

According to an EPA study, average noise levels in an urban environment are not hazardous to human hearing (EPA 1974). Urban noise would be more appropriately classified as an annoyance resulting in interference with activity, particularly speech communication (EPA 1974). Since most buildings offer effective noise shielding for their occupants, this section focuses on annoyance and interference with outside activities resulting from operational noise associated with the proposed project. Noise mitigation resulting from construction activities is not addressed because the potential impacts are exempt from local and state regulations. There are no federal regulations that apply to mitigation of construction noise.

3.9.1 Noise Background and Characteristics

Sound is created when objects vibrate, resulting in a minute variation in surrounding atmospheric pressure called sound pressure. The human response to sound depends on the magnitude of a sound as a function of its frequency and time pattern (EPA 1974). Magnitude describes the physical sound in the air. The range of magnitude from the faintest to the loudest sound humans can hear is so large that sound pressure is expressed on a logarithmic scale in units called decibels (dB). Magnitudes of typical noise levels are presented in Table 3.9-1.

Table 3.9-1: Sound Pressure Levels of Representative Noises

Source	Decibels	Description
Large rocket engine (nearby)	180	
Jet takeoff (nearby)	150	
Pneumatic riveter	130	
Jet takeoff (200 feet)	120	Pain threshold
Construction noise (10 feet)	110	
Subway train	100	
Heavy truck (50 feet) and Niagara Falls	90	Constant exposure endangers hearing
Average factory	80	
Busy traffic	70	
Normal conversation (3 feet)	60	
Quiet office	50	Quiet
Library	40	
Soft whisper (16 feet)	30	Very quiet
Rustling leaves	20	
Normal breathing	10	Barely audible
Hearing threshold	0	

Source: Tipler 1976

Humans respond to a sound's frequency or pitch. Environmental noise is composed of many frequencies, each occurring simultaneously at its own sound pressure level. As measured by an electronic sound level meter, frequency weighting combines the overall sound frequency into one sound level. The commonly used frequency weighting for environmental noise is A-weighting, or dBA, which approximates how an average person hears sounds. C-weighting, or dBC, is a measure of the lowest frequencies of sound and vibration. Low frequency noise is usually described as humming or engine-like sounds or a feeling of pressure or vibration.

Loudness, compared to physical sound measurement, refers to how people subjectively judge a sound and varies from person to person. A listener often judges an increase of 10 dBA to be twice as loud. In general, an increase in noise from 1 to 3 dBA will not be noticeable, 3 to 5 dBA will be noticeable to most people, 5 to 7 dBA will be easily heard, and 7 to 10 dBA will be judged as substantial.

Because of the logarithmic decibel scale, a doubling of the number of noise sources, such as traffic volume, increases noise levels by 3 dBA. A tenfold increase in the number of noise sources will add 10 dBA. Thus, a noise source emitting a noise level of 60 dBA combined with another noise source of 60 dBA results in a combined noise level of 63 dBA, not 120 dBA.

Audible noise levels depend on a variety of factors including, but not limited to, topography, vegetation, distance from the source to receptor, and whether the source of the noise is stationary or moving. Noise levels decrease with distance from the noise source. Traffic noise levels will decrease 3 dBA over hard ground (concrete or pavement) or 4.5 dBA over soft ground (grass) for every doubling of distance between the source and the receptor. For a point source such as stationary construction equipment, noise levels will decrease between 6 and 7.5 dBA for every doubling of distance from the noise source.

A descriptor for audible noise is the equivalent sound level (L_{eq}). L_{eq} is defined as the constant level that, over a given period of time, transmits to the receptor the same amount of acoustical energy as the actual time-varying sound. For example, two sounds, one of which contains twice as much energy but lasts only half as long, have the same L_{eq} noise levels. The L_{eq} can be considered a measure of the average noise level during a specified period of time. It is a measure of total noise, a summation of all sounds during a time period. As such, it places more emphasis on occasional high noise levels than accompanying general background noise levels.

Noise Regulations

Applicable agency noise regulations and guidelines provide a basis for defining and evaluating noise impacts and mitigation for the proposed project. Noise regulations and guidelines specify limits of noise levels, above which noise is considered an impact. Maximum permissible noise levels apply to a single source of noise and depend on the zoning district of both the source of noise and the receptor property.

Federal Noise Regulations

Other than the Occupational Safety and Health Administration (OSHA) regulations, no other federal noise regulations would govern sound at the proposed project.

Washington State Department of Ecology Noise Standards

Chapter 173-60 of the WAC specifies maximum environmental noise levels. The limits are based on the noise source and the receptor. The noise level designations shown below are the maximum levels permitted from an industrial facility:

Residential Day (7 a.m. to 10 p.m.)/Night (10 p.m. to 7 a.m.): 60/50 dBA
- Commercial: 65 dBA
- Industrial: 70 dBA

Maximum noise levels outlined above are allowed a 5 dBA increase for 15 minutes in one hour, a 10 dBA increase for 5 minutes in one hour, or a 15 dBA increase for 1.5 minutes in one hour.

Noise from temporary construction activities is exempt from all limits, except for those that apply to noise received at residential properties at night (10 p.m. to 7 a.m.) (WAC 173-60).

Whatcom County Noise Ordinance

The Whatcom County Zoning Code (Title 20) includes general prohibitions against noise as a nuisance or annoyance. It also defines some acts that are declared unnecessary noises, although none apply to the normal operation of a power generation facility. There are no numerical noise limits in the Whatcom County Code, and all references are to the state code. Therefore, the limits in WAC 173-60 were used to evaluate the estimated noise effects resulting from the operation of the proposed project.

Impact Criteria for Low Frequency Noise

Although the state of Washington regulates low frequency noise through noise regulations using the A-weighted decibel scale, the American National Standards Institute (ANSI) presents recommendations to provide protection from low frequency noise disturbance in *Gas Turbine Installation Sound Emissions* (ANSI 1989). ANSI recommends limiting noise levels at residences near new gas turbine facilities to 75 to 80 dBC.

3.9.2 Existing Conditions

Golder Associates, Inc. (BP 2002) performed a noise monitoring study to assess the existing noise levels at 15 locations within the project vicinity. Noise levels were monitored on May 31 and June 7, 2001. The noise monitoring program was performed at the property boundaries of the refinery, at the proposed cogeneration facility site, and at the nearest residences located from 1 to 2 miles away. Monitoring also was performed at the entrance to Birch Bay State Park. The locations are described in Table 3.9-2 and shown in Figure 3.9-1.

Table 3.9-2: Noise Monitoring Locations

Location Number	Type of Receiver	Description
1	I	On Grandview Road in front of the Chemco Plant, 0.69 mile northeast of the proposed project site
2	R	Northwest corner of the four-way stop at Aldergrove Road and Kickerville Road intersection, 1.26 miles southeast of the project site
3	I	Aldergrove Road at the entrance to the PraxAir facility, 0.82 mile south of the proposed project site
4	I	Southeast corner of two-way stop at the Aldergrove Road and Jackson Road intersection, 1.37 miles southwest of proposed project site
5	I	At Cascade Natural Gas regulator station on the west side of Jackson Road, 1.11 miles southwest of proposed project site. (The regulator was not operating.)
6	I	Southeast corner of four-way stop at the Grandview Road and Jackson Road intersection, 1.10 miles west of proposed project site
7	R	West side of Jackson Road at the Birch Bay Community Church, 1.22 miles northwest of proposed project site
8	R	Southwest corner of the three-way stop at Grandview Road at Point Whitehorn, 2.08 miles west of the proposed project site
9	R	Northwest corner of Jackson Road and Helweg, 1.44 miles northwest of the proposed project site
10	R	In front of the residence at 4570 Bay Road, 1.20 miles north of the proposed project site
11	R	Northwest corner of the four-way stop at Kickerville Road and Bay Road, 1.48 miles northeast of the proposed project site
12	I	Intersection of Grandview Road and Blaine Road on the south side of the street, 300 feet north of the proposed project site
13	I	West side of Blaine Road north of Grandview Road at the turnout, 0.51 mile north of the proposed project site
14	R	Northwest corner of Kickerville Road and Brown Road, 1 mile east-southeast of the proposed project site near the residence closest to the site
15	R	Birch Bay State Park near the park entrance, 1.92 miles northwest of the proposed project site
Project Site		Open field on Applicant property south of Grandview and east of the refinery.

I Industrial Receiver
R Residential Receiver

For the Golder study, locations 1 through 15 were monitored for two periods of 15 minutes, once in the hours defined as day (7 a.m. through 10 p.m.) and once in the hours defined as night (10 p.m. through 7 a.m.). The project site location described in the table above was monitored for a period of 24 hours. No unusual natural environmental circumstances were present such as heavy wind or rain that would have influenced the field measurements.

In a second, more recent study, Hessler Associates (2003) conducted a noise monitoring program that included more extensive background sound level measurements at four locations representative of the nearest sensitive receptors in the Golder study (Receptors 7, 10, 11, and 14). The same environmental conditions were measured for each study, however the time duration for the measurements spanned three nights and two days. These measurements began on April 8, 2003 and concluded on April 11, 2003.

Figure 3.9-1: Noise Monitoring Locations

Two types of ambient noise were monitored during data collection. The first type of noise is steady noise or background noise. Background noise in the project vicinity includes the steady sound of wind, creeks, wave action, and nearby industrial sources. The second type of noise monitored during data collection is transient noise, with sources that include vehicular traffic, wind gusts, airplanes, animals, trains, and other human-caused disturbances.

The results of the noise measurements indicated that the existing noise levels, which are made up of background sound levels including transient noise, in the areas surrounding the proposed project range from a low of 47 dBA to a high of 68 dBA during the day (7 a.m. to 10 p.m.) and from a low of 39 dBA to a maximum of 65 dBA during the night (10 p.m. to 7 a.m.). Differences in existing noise levels depended mainly on the proximity of transient noise sources. The average contribution of transient noise is 4 to 12 dBA. The results of existing conditions for day and night periods are presented in Table 3.9-5.

To avoid private property access issues, noise monitoring was performed on public property along public roads near transient noise generated by vehicular traffic. The results of this noise monitoring indicate that the background levels are low, and are significantly influenced by transient sources, especially vehicular traffic. If sampling had been performed on the private property farther away from the road, at particular homes for example, the influence of passing vehicles would be reduced and a stronger assessment of existing backgrounds conditions could be established.

As shown in Table 3.9-5, some of the residential receptors' existing noise levels are shown to exceed the regulatory limit outlined in the WAC 170-60. Without knowing the distance of the property from the measurement location, it is difficult to determine the exact noise levels at the property. However, as stated above, transient noise from passing traffic contributed significantly to the overall L_{eq} level reported in the table.

3.9.3 Impacts of the Proposed Action

Construction

Construction activities of the proposed project are expected to be typical of other industrial plant construction projects. Construction activities include mobilization, site preparation, utility development, heavy equipment movement, clearing/grading of roadways and right-of-ways, and installation of the new facility components. General construction equipment to be used includes but is not limited to: heavy, medium, and light equipment such as excavators; roller compactors; front-end loaders; bulldozers; graders; backhoes; dump trucks; water trucks; concrete trucks; pump trucks; utility trucks; cranes; pile drivers; man lifts; forklifts; and lube, oil, and fuel trucks. The levels of noise produced during these activities are anticipated to vary depending on the construction phase. Table 3.9-3 outlines typical construction noise levels at a distance of 50 feet.

In addition to noise produced from onsite construction equipment, traffic volumes would increase as construction employees commute to and from work at the site. Additional transient noise would occur as a result of increased volumes of delivery and service vehicles (including trucks of various sizes) doing business at the site. Truck and delivery traffic is further discussed in Section 3.15, Traffic and Transportation. The construction traffic is temporary and expected to occur during the daytime hours of 7 a.m. and 6 p.m. Under these conditions, the transient construction traffic is exempt from state regulations.

Table 3.9-3: Construction Equipment Noise Ranges

Equipment	Examples	Noise Level (dBA) at 50 feet
Earth Moving	Compactors, loaders, backhoes, tractors, graders, pavers	73-96
Materials Handling	Concrete mixers and pumps, cranes, derricks	74-88
Stationary	Pumps, compressors, generators	69-87
Hauling	Trucks	83-94
Impact Equipment	Pile drivers	95-106
Impact Tools	Jackhammers, rock drills, pneumatic wrenches	81-98

Source: EPA 1971

Noise associated with construction activities is highly variable and is exempt from Washington State noise standards, as stated in WAC 173-60-050, with the exception of residential locations between the hours of 10 p.m. and 7 a.m.

Because construction noise is exempt from Washington State standards, no construction-phase noise modeling was conducted. Other impacts from construction noise may include effects on wildlife. Disturbances caused by construction on the project site may affect wildlife in adjacent habitats by disrupting feeding and nesting activities. Habitats on and surrounding the site may be used for breeding by migrant and resident songbirds. Increased noise levels created by operation of heavy machinery could cause birds to abandon their nests and may temporarily displace wildlife during construction. Once construction activities are complete, wildlife may resume use of the area. Construction and operational impacts on wildlife are addressed in Section 3.7 of this EIS.

Operation

Both the Golder and Hessler noise studies predicted operational noise levels at the chosen 15 receptors. Each study estimated noise levels at the selected offsite receptors, based on the anticipated noise levels produced by the proposed cogeneration facility without inclusion of the background or transient sounds. The baseline analysis assumed standard power-generating equipment would be used throughout the facility without any special or unusual improvements specifically intended to reduce far-field noise. This calculation indicated that the noise levels of the proposed project would be below the regulatory daytime and nighttime allowable levels as shown in Table 3.9-4.

After initial modeling, the Hessler study found that a moderate reduction in HRSG stack noise would significantly lower the overall noise levels facility-wide. Consequently, the Applicant recommended the addition of stack silencers with a nominal reduction of 10 dBA in stack sound; it was accepted and incorporated into the project design. With this improvement, total noise levels at some of the more critical locations will be reduced by 3 to 4 dBA. The stack silencers also carry an additional benefit that stack noise is less likely to adversely affect levels at receptors situated downwind from the facility. The high elevation of the stacks makes their noise more susceptible to wind effects.

Each study assumed the primary noise-generating equipment would consist of three CTGs, one STG, three HRSGs, and an air/water cooling tower. Modeling assumed that the CTGs and STG would be housed within standard, acoustically treated enclosures (but not within buildings). The Golder study did not assume any stack silencers on the HRSGs, however the Hessler study did incorporate this new design feature into the final model. Besides the main components, other equipment that could generate potentially significant noise levels, such as boiler feedwater pumps, circulating water pumps, main transformers, and various steam lines, were included in the model. To ensure the modeling results are conservative, the noise impact modeling predicted the maximum noise levels to be produced by the proposed project. To achieve these conditions, no attenuation factors, such as vegetation or topography, were included in the modeling for existing or future noise results.

Table 3.9-4 presents the projected noise levels of the proposed project at the 15 receptors as originally modeled by Golder and then by Hessler following the design inclusion of stack silencers.

Table 3.9-4: Estimated Noise Levels without Background Ambient Sound Levels (L_{eq} dBA)

Receptor Location	Golder's Predicted Noise Level	Hessler's Predicted Noise Level (with stack silencers)	Most Stringent State Regulatory Limit (nighttime)
1 (I)	52	47	70
2 (R)	45	41	50
3 (I)	50	46	70
4 (I)	43	39	70
5 (I)	46	40	70
6 (I)	46	41	70
7 (R)	44	40	50
8 (R)	38	34	50
9 (R)	42	38	50
10 (R)	45	40	50
11 (R)	42	40	50
12 (I)	65	60	70
13 (I)	54	48	70
14 (R)	48	44	50
15 (R)	39	35	50

I=industrial, R=residential

As shown above, all of the modeled noise levels produced solely by the cogeneration facility would be below the state regulatory thresholds. Because stack silencers were added to the project design, Hessler's modeled results were used to calculate the noise levels at the 15 receptor locations to include the background noise conditions combined with the noise produced from the cogeneration facility. Table 3.9-5 outlines the existing background conditions measured by

Golder, the estimated combined noise levels as predicted by Hessler (existing conditions plus the predicted cogeneration noise levels with stack silencers), and the regulatory limits for daytime and nighttime.

Table 3.9-5: Estimated Noise Levels Combining Modeled and Background Sources (L_{eq} dBA)

Receptor	Daytime Noise Level				Nighttime Noise Level			
	Existing Condition	Existing Condition plus Modeled Level with Stack Silencers	Regulatory Limit	Increase above Existing Condition	Existing Condition	Existing Condition plus Modeled Level with Stack Silencers	Regulatory Limit	Increase above Existing Condition
1 (I)	68	68	70	0	65	65	70	0
2 (R)	58	59	60	1	63	63	50	0
3 (I)	61	61	70	0	60	61	70	1
4 (I)	50	51	70	1	52	53	70	1
5 (I)	63	63	70	0	58	58	70	0
6 (I)	61	61	70	0	59	59	70	0
7 (R)	63	63	60	0	56	56	50	0
8 (R)	55	55	60	0	52	52	50	0
9 (R)	57	57	60	0	50	50	50	0
10 (R)	62	62	60	0	54	54	50	0
11 (R)	61	61	60	0	53	53	50	0
12 (I)	64	65	70	1	61	63	70	2
13 (I)	62	62	70	0	57	57	70	0
14 (R)	60	60	60	0	51	52	50	1
15 (R)	47	48	60	1	39	40	50	1

I=industrial, R=residential

The modeling results presented in Table 3.9-5 indicate that none of the 15 receptors would experience a perceptible increase (above 3 dBA) in noise during the daytime or evening. Only one receptor would experience a noise increase over 1 dBA. Receptor 12 is estimated to increase 2 dBA at night over existing noise conditions. This location is located 0.1 mile north of the cogeneration project on industrially zoned BP property across from Grandview Road. A 2 dBA increase is not expected to be perceivable and would not exceed state regulatory limits.

The changes in noise levels would also not be perceptible to residences situated farther away in the communities of Birch Bay and Cottonwood.

Low Frequency Noise Results

Localized disturbance from low frequency noise has sometimes been associated with simple-cycle combustion turbine installations. Combustion turbines are capable of producing high levels of low frequency (40 Hz or less) noise when the exhaust gas exits the equipment. In simple-cycle configurations, the exhaust gas passes through an exhaust silencer that is effective at reducing mid- and high frequency noise but is less effective at reducing low frequency noise emissions.

Low frequency noise, however, has not typically been a reported concern when combustion turbines are placed in combined-cycle configurations. In combined-cycle configurations, the exhaust gas passes through the HRSG equipment, which is effective at reducing the low frequency combustion noise associated with turbine operation. The cooling of the exhaust gasses in combined-cycle facilities also reduced the low frequency noise emissions.

As with the original Golder modeling study, the newer Hessler modeling also evaluated low frequency noise levels at the receptors. In general, the new modeling results indicate that low frequency noise from the cogeneration facility (C-weighted sound levels and the lower frequency levels) would be similar to or less than the levels reported by Golder for the original project configuration. Consequently, both studies conclude that low frequency noise would not reach perceptibility thresholds at any of the residential receptors. The normal threshold of perceptibility for low frequency noise and vibration is 75 to 78 dBC (ANSI 1989). The ANSI recommends C-weighted plant levels should be significantly below 75 dBC at residential receptors.

Table 3.9-6 shows the lowest frequency bands and the overall C-weighted sound level at each receptor location. All receptors, with the exception of the industrial property at Receptor 12, are predicted to experience low frequency noise well below the 75 dBC residential recommendation.

Table 3.9-6: Summary of Low Frequency Receptor Levels due to the Cogeneration Base Load Plant Operation

Receptor	Total Level (dBC)
1 (I)	63.8
2 (R)	59.4
3 (I)	62.8
4 (I)	58.4
5 (I)	58.7
6 (I)	58.9
7 (R)	58.7
8 (R)	54.3
9 (R)	57.3
10 (R)	58.6
11 (R)	58.2
12 (I)	73.3
13 (I)	64.8
14 (R)	61.0
15 (R)	55.4

I=industrial, R=residential

Other low frequency noise to be considered is “corona” discharge. When water droplets stand on the transmission line’s conductor surface, small-radius irregularities increase the electrical stresses that can lead to audible, low frequency humming and crackling. Corona discharge is often weather-dependent. Because the new 230-kV transmission system would be located more than 0.5 mile from the nearest residence and a new transmission line in the Custer/Intalco transmission corridor (if Option 2 is selected) would be within the existing 125-foot utility ROW, disruptive corona effects on local residences are not anticipated.

3.9.4 Impacts of No Action

Under the No Action Alternative, the proposed project would not be constructed and noise would remain at levels documented in the existing conditions section.

3.9.5 Secondary and Cumulative Impacts

Georgia Strait Crossing Pipeline LP is proposing to construct a pipeline and compressor station to deliver gas from Sumas to Vancouver Island. The compressor station is proposed at Cherry Point west of the refinery. The noise study for the compressor station project evaluated expected noise levels at the north, south, east, and west property boundaries of the compressor station (Williams Gas Pipeline West 2001), where the maximum noise level would occur. The levels ranged between 46 and 54 dBA. The nearest receptor to the Georgia Strait Pipeline project is Receptor 5, the industrial power plant. The expected 54 dBA from the north boundary of the compressor station falls below the predicted 63 dBA of the cogeneration facility. Given the additional distance from the northern property boundary of the Georgia Strait Crossing compressor station and the location of the power plant, cumulative operation noise impacts are not expected to occur.

Impacts on various receptors identified in this study may occur during the construction phase of the Georgia Strait Crossing project. These impacts may occur at receptors located near the proposed compressor station or near where the pipeline is placed in the ground. As with the proposed project, construction noise is considered temporary and is exempt from Washington State noise standards. However, site-specific construction plans for areas where there are residences or structures within 50 feet of the construction right-of-way would address noise minimization.

3.9.6 Mitigation Measures

Construction

The Golder noise study indicated that construction noise could be reduced by providing mufflers on engines, using quieter equipment or construction practices, and turning off equipment when not in use. To reduce construction noise at nearby receptors, the construction industry’s best management practices would be incorporated into construction plans and contractor specifications. The proposed project would include the following noise mitigation measures during construction:

- Limiting noisier construction activities to between 7 a.m. and 10 p.m. would reduce construction noise during sensitive nighttime hours. If construction were to occur outside this period, measures to minimize noise would be implemented to the maximum extent possible.

- Equipping engines of construction equipment with adequate mufflers, intake silencers, or engine enclosures would reduce their noise by 5 to 10 dBA (EPA 1971).
- Specifying the quietest equipment available would reduce noise by 5 to 10 dBA.
- Turning off construction equipment when not in use for prolonged periods would eliminate noise from the equipment during those periods.
- Requiring contractors to maintain all equipment and train their equipment operators would reduce noise levels and increase efficiency of operation.
- Locating stationary equipment away from receiving properties would decrease noise from that equipment in relation to the increased distance.

Operation

Although no noise impacts requiring mitigation would result from operation of the proposed cogeneration facility, the design and siting of the facility have integrated many noise mitigation measures.

When considering the location and orientation of the proposed project, many factors including noise were evaluated. The project site was set back approximately 340 feet from the centerline of the nearest public road, Grandview Road, and this resulted in a reduction of noise levels at the road and beyond. The configuration of the project equipment, which includes the three gas turbine generators perpendicular to Grandview Road, is an orientation that allows for optimal sound reduction through physical barriers. The equipment noise from the two most southern generators would be blocked by the presence of the generator closest to Grandview Road.

The three gas turbine generators and the steam turbine generators would be located within enclosures, which would attenuate sound. The HRSG exhaust stacks have also been designed with silencers to provide additional noise mitigation. This operation mitigation is demonstrated in the modeling completed by Hessler and outlined in Table 3.9-4.

3.9.7 Significant Unavoidable Adverse Impacts

None of the receptors in the modeling program would experience significant increases in noise levels. Implementing BMPs during the construction of the project will reduce the temporary construction noise impacts at nearby receptors. Thus, no significant unavoidable adverse impacts are associated with construction or operation of the project.